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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---------------------------|-------------|----------------------|-----------------------|------------------|
| 10/654,770 | 09/04/2003 | Wan-Jae Park | 8836-187 (IB12089-US) | 6694 |
| 22150 | 7590 | 09/06/2005 | EXAMINER | |
| F. CHAU & ASSOCIATES, LLC | | | TRAN, BINH X | |
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DATE MAILED: 09/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | |
|------------------------------|--------------------------|------------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 10/654,770 | PARK ET AL. |
| | Examiner Binh X. Tran | Art Unit 1765 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 12 August 2005.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-14 is/are rejected.
- 7) Claim(s) 15-17 is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date: _____ | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Jang et al. (US 6,362,093).

Respect to claim 1, Jang discloses a dual damascene process comprising:

sequentially forming a first etch stopping layer (12), a bottom intermetal dielectric layer (14), a second etch stop layer (16) and an upper intermetal dielectric layer (18) on the entire surface of a semiconductor substrate (10) having a bottom interconnection (11) (Fig 1, col. 6 lines 10-65);

successively patterning the upper intermetal dielectric layer (18), the second etch stopping layer (16), and the bottom intermetal dielectric layer (14) by using a first etch recipe (etching plasma 22) to form a first recessed region exposing a predetermined region of the first etch stop layer (12) (Fig 2, col. 8 line 35-63);

forming a bottom-protecting layer (24) having a planarized surface on the upper intermetal dielectric layer and in the first recessed region (col. 9 lines 20-65);

successively patterning the bottom protecting layer (24) and the upper intermetal dielectric layer (18) by using a second etch recipe (plasma 28) to form a second recessed region being overlapped with the first recessed region and having a wider width than the first recessed region (Fig 4);

selectively removing the bottom protecting layer (14) to expose the predetermined region of the first etch stopping layer (12) (col. 11 lines 9-20);

removing the first etch stop layer exposed by at least the first recessed region to expose the bottom interconnect (col. 11 lines 34-45).

Jang does not explicitly disclose the second etch recipes uses an etch gas that makes an etch selectivity of the upper intermetal dielectric layer with respect to the bottom protecting layer to be about 0.5 to about 1.5. However, Jang clearly teaches the second etch recipes uses an etch gas that etch the protecting layer (24) at a rate at least somewhat lower than the upper intermetal dielectric layer (col. 10 lines 55-65). Since the protecting layer is etched a rate somewhat lower than the upper intermetal dielectric, the selectivity (i.e. etch rate ratio) of the protecting layer with respect to the upper intermetal dielectric layer must be approximately or less than 1. Therefore, the selectivity of the upper intermetal dielectric layer with respect to the bottom protecting layer must be approximately or greater than 1 (read on applicants' range).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jang as applied to claim 1 above, and further in view of Hill et al. (US 6,753,250).

Respect to claim 2, Jang fails to disclose the upper and bottom intermetal dielectric layers comprise silicon oxycarbide. However, Jang clearly discloses the upper and bottom dielectric layers (14 and 18) comprise silicon oxide dielectric material or other dielectric materials (col. 7 lines 46-53). In a dual damascene process, Hill teaches to use dielectric material including silicon oxide or silicon oxycarbide for the top and bottom intermetal dielectric layer (col. 8 lines 43-52). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Jang in view of Hill by using silicon oxycarbide because equivalent and substitution of one for the other would produce an expected result.

6. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jang as applied to claim 1 above, and further in view of Wang et al. (US 6,057,239).

Respect to claim 3, Jang fails to disclose the bottom protecting layer comprises hydrogen silsesquioxane (HSQ). However, Jang clearly discloses the bottom protecting layer is spin-on material (col. 9 lines 36-50). In a dual damascene process, Wang teaches the bottom protecting layer (40) comprises spin on material or HSQ (col. 3 lines 8-12). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Jang in view of Wang by using HSQ because equivalent and substitution of one for the other would produce an expected result.

7. Claims 4-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang as applied to claim 1 above, and further in view of Bjorkman et al. (Us 6,858,153).

Respect to claims 4-8, Jang fails to disclose the etch gas comprises a high-ratio fluorocarbon (e.g. C₄F₈) and a low-ratio fluorocarbon (e.g. CF₄). However, Jang clearly discloses the plasma etch comprises low ratio fluorocarbon (CF₄) for etching dielectric material to form dual damascene (col. 8 lines 50-63). In a dual damascene process, Bjorkman teaches to use a gas comprise high ratio fluorocarbon (e.g. C₄F₈), low ratio fluorocarbon (e.g. CF₄) and inert gas to etch dielectric material (col. 19 lines 20-40). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Jang in view of Bjorkman by using etch gas comprises C₄F₈, CF₄ because this composition is capable of etching dielectric material with high uniformity.

Respect to claim 9, Bjorkman teaches to use 20 sccm of C₄F₈ and 40 sccm of CF₄ (col. 19 lines 23-36). The flow rate ratio of high ratio fluorocarbon (C₄F₈) with respect to low ratio fluorocarbon is 20 sccm / 40 sccm = 0.5 (read on applicants' range).

8. Claims 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang as applied to claim 1 above, and further in view of Dalton et al. (US 6,720,249).

Respect to claim 10-13, Jang fails to disclose the etch gas comprises a high-ratio fluorocarbon (e.g. C₄F₈) and a fluorohydrocarbon (e.g. CHF₃). However, Jang clearly discloses the plasma etch comprises fluorohydrocarbon (CHF₃) for etching dielectric material to form dual damascene (col. 8 lines 50-63). In a dual damascene process, Dalton teaches to use a gas comprises high ratio fluorocarbon (e.g. C₄F₈) and fluorohydrocarbon (e.g. CHF₃) to etch dielectric material layers (col. 6 lines 40-45, col. 7 lines 1-10). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Jang in view of Dalton by using etching gas comprises C₄F₈ and CHF₃ because this is a conventional etching gas for the dielectric materials.

Respect to claim 14, Dalton teaches to use 100 sccm of C₄F₈ and 100 sccm CHF₃ (col. 7 lines 1-7). The flow rate ratio of high ratio fluorocarbon (C₄F₈) with respect to fluorohydrocarbon is 100 sccm / 100 sccm = 1 (read on applicants' range).

Allowable Subject Matter

9. Claims 15-17 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter: The cited prior arts fail to disclose the steps of forming a bottom layer on the substrate and forming an interlayer on the bottom layer and patterning and patterning the interlayer to form a trench and filling the trench with a conductive material to form

the bottom interconnection in conjunction with all other limitation in the claims. The closest prior art (Jang) teaches to form the bottom interconnection inside the substrate (10).

Response to Arguments

11. Applicant's arguments filed 8-12-2005 have been fully considered but they are not persuasive.

The applicants argue that "Jang's selectivity (the etch rate ratio) need only be approximately or greater than 1, but not about 0.5 to about 1.5". This argument is not persuasive. As point out by applicants, Jang teaches the selectivity of approximately about 1. According to the MPEP 2131.03 (anticipation of ranges), "a specific example in the prior art which is within a claimed range anticipated the range". The selectivity approximately equals 1 in Jang's reference certainly fall within applicant's selectivity of "about 0.5 to about 1.5", therefore Jang's reference anticipated the range claimed by applicants.

Respect to claim 2, applicants argue "the motivation to modify the prior art must flow from some teaching the in art". According to applicants, "there is no such teaching in Hill". The examiner strongly disagrees. In col. 8 lines 43-52, Hill clearly teaches to use silicon dioxide or silicon oxycarbide for the dielectric layer. Thus, the examiner interprets Hill teaches it is possible or obvious to replace silicon oxycarbide with silicon dioxide for the dielectric layer.

Respect to claim 3, applicants argue that there is no motivation to modify Jang in view of Wang by using replace spin on glass with HSQ. The examiner disagrees.

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Jang clearly discloses the bottom protecting layer is spin-on material (col. 9 lines 36-50). In a dual damascene process, Wang teaches the bottom protecting layer (40) comprises spin on material or HSQ (col. 3 lines 8-12). Thus, the examiner interprets Wang teaches it is obvious to replace substitute HSQ for a spin on material.

Respect to claims 4-9 and 10-14, the examiner still maintains the previous 35 USC 103 rejections. The motivation for modify Jang in view of Bjorkman (claims 4-9) and the motivation for modify Jang in view of Dalton (claims 10-14) clearly suggested in the secondary reference (i.e. Bjorkman or Dalton).

Conclusion

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-

1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh X. Tran

NADINE G. NORTON
SUPERVISOR

